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Does alcohol consumption affect the glycosylated haemoglobin values of an individual with insulin dependent diabetes mellitus?

Erin Kirk
University of Wollongong

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Does Alcohol Consumption Affect The Glycosylated Haemoglobin Values Of An Individual With Insulin Dependent Diabetes Mellitus?

by
Erin Kirk

This major project is presented as part of the requirement for the degree of Master of
Science (Nutrition and Dietetics) of the University of Wollongong

November, 1995



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ABSTRACT

Hyperglycaemia amongst individuals with Insulin Dependent Diabetes Mellitus (IDDM), can lead to the development of chronic diabetic complications. The Glycosylated Haemoglobin (HbA1c) assay retrospectively measures the extent of an individual's hyperglycaemic episodes in the last 8 - 12 weeks. Elevated HbA1c values significantly correlate with the development of diabetic complications.

Previous research concerning the hyperglycaemic effects of alcohol among individuals with IDDM is conflicting. Authors have reported contrasting results, ranging from the impairment of glucose tolerance, to the enhancement of glucose tolerance, to no effects on glucose metabolism at all. This uncertain relationship is also corroborated by the previous research on the effects of alcohol consumption towards HbA1c, where researchers, report both an association between alcohol consumption and elevated HbA1c and alcohol, and no association at all. This present study was undertaken to determine the effects of alcohol consumption towards the elevation of HbA1c values.

Twenty-one diabetic subjects and 15 non diabetic controls, aged between 18-30 years, residing in the Illawarra area, were recruited for this study. Glycosylated Haemoglobin was measured as HbA1c; by means of high performance liquid chromatography. Collection of alcohol consumption was by three methods; a modified Burke diet history, and questions taken from both the National Heart Foundation (NHF) risk factor prevalence study, and the Diabetes Control and Complications Trial

(DCCT) food pattern questionnaire. Results of all three methods were cross-checked to test the validity of each method.

The results of this study indicated a higher consumption of alcohol amongst controls than the diabetic population. Within the diabetic population, males consumed more alcohol compared to the female sample. The distribution of HbA1c levels was not as expansive or elevated as demonstrated by previous studies. Individuals with a higher than recommended HbA1c value appeared to consume alcohol more frequently and in a greater quantity; specifically above the recommended values. These observations were not significant and were only viewed as trends. A significant difference was observed between the grams of alcohol consumed and HbA1c in the diabetic group ($p<0.05$), but not amongst the control group. However, this significance disappeared once an outlier in the diabetic sample was removed.

This present study supports trends, but suggests no significant difference between HbA1c and alcohol consumption. These trends may prove significant if a larger study was examined. Hence, it is not recommended for diabetic individuals to consume unlimited amounts of alcohol, as the relationship between alcohol consumption and HbA1c levels is unclear.

Chapter 1. Introduction

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Disruptions in euglycaemic control are undesirable among individuals with Insulin Dependent Diabetes Mellitus (IDDM); especially when combined with elevated blood glucose levels (hyperglycaemia). The implications of hyperglycaemia concern the precipitation of predominantly vascular complications (Fletcher, 1987). The glycosylated haemoglobin assay (HbA1c), is a biochemical assay which becomes elevated when an individual, especially one with diabetes, experiences hyperglycaemia (Zeman, 1991). Excessive alcohol intake has been known to indirectly cause episodes of hypoglycaemia or hyperglycaemia (Avogaro & Tiengo, 1993). This project investigates the observed effects of alcohol consumption, in reference to the HbA1c values of an individual.

Hyperglycaemia tends to have a long term effect on the diabetic individual (Fletcher, 1987). Problems which occur include macrovascular complications and microvascular complications (Zeman, 1991). Development of such complications may shorten the lifespan of the diabetic individual (Fletcher, 1987). Kullberg & Arnqvist (1993) report the significant occurrence of retinopathy with higher measures of HbA1c. This indicates HbA1c values are invaluable in the assessment of glucose control of the diabetic individual, to impede the development of long term complications (Kullberg & Arnqvist, 1993).

HbA1c is the major molecular form of the three glycosylated haemoglobin plasma components (Gonen et al, 1977). The HbA1c assay measures the percentage of plasma haemoglobin that has become glycosylated (Greenspan, 1989). The glycosylation of haemoglobin is irreversible, and hence an elevated level only declines after the molecule has been destroyed (Zeman, 1991). Each haemoglobin molecule has a life span of approximately 120 days (Fox, 1990), therefore the HbA1c assay has a retrospective application of about eight to twelve weeks (Kullberg & Arnqvist, 1993).

HbA1c has been closely associated with diabetes control (Zeman et al, 1991). The research of Nathan et al (1984) supports the hypothesis that HbA1c levels are useful for measuring metabolic control amongst people with diabetes, within a retrospective three month time span. Nathan et al (1984) compared the value of HbA1c level for each diabetic subject, to a physician's estimation of blood glucose control. The physician estimated this 'control' by considering the physiological symptoms of the patient over a ten week period. This estimated value was directly compared to actual mean blood glucose levels. The HbA1c levels were proven the more valid method for determining blood glucose control. The HbA1c value correlated much closer to actual mean blood glucose levels than the physician's subjective estimate (Nathan et al, 1984).

Explanations of the mechanisms to the altered metabolism precipitated by alcohol amongst people with diabetes are conflicting with current research describing both an impairment in glucose tolerance and no effects at all (Marks, 1978). It is imperative to assess the effect that alcohol intake has towards the glucose control of the individual with diabetes to impede any development of complications which may occur (Walsh & O'Sullivan, 1971).

In summary, the aims of this project were twofold:

- 1). to adequately record the frequency of alcohol intake and quantity of alcohol consumed within an accurate sample of diabetic and controls, aged between 20 - 30 years, residing in the Illawarra region and,
- 2). to study the effect of alcohol consumption towards blood glucose control of subjects by measuring HbA1c levels amongst subjects.

It is hypothesised that :

- 1). the individual with IDDM will consume a lower amount of alcohol than compared to the control group and,
- 2). a greater frequency and quantity of alcohol consumption will lead to a higher HbA1c value amongst diabetic subjects.

Chapter 2. Literature Review

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2.1. Accurate Measurement of Alcohol Intake

Validation of measuring alcohol intake within a specific sample population involves the recruitment of all possible study participants and the utilisation of research methods which promote participants to accurately report alcohol intake. The measurement of alcohol content may be accurately reported when the following parameters are considered:

- analysis of the prevalence of IDDM (Scott & Brown, 1991) (**Section 2.1.1.**)
- the participation levels of subjects (Humphreys et al, [1994]; Shimakawa et al, [1993]) (**Section 2.1.2.**)
- identification of most accurate and appropriate method to produce a valid measure of alcohol consumption (Block, 1982) (**Section 2.1.3.**)
- observation of alcohol intake trends (Risk Factor Prevalence Study Management Committee, [1990]; Close et al, [1992]) (**Section 2.1.4.**)

2.1.1. Prevalence of IDDM

Documentation of adult IDDM prevalence in the Illawarra region, is non-existent. A register has been developed for Illawarra diabetic children aged between 0-19 years (Moses & Mathews, 1986), however, these results are not applicable to an adult population. Scott & Brown (1991) developed a register of adult IDDM patients, initially derived from clinic attendance in Canterbury, New Zealand. Scott & Brown (1991), based their research on a exhaustive search of a centralised diabetes education service and local general practitioners. The researchers revealed that for the sample of

20-29 years, the prevalence of IDDM was 71/300 000 (Scott & Brown, 1991). Such statistics may be directly applicable to the Illawarra population, as Australia (ranked 20) and New Zealand (ranked 24) were compatible in a recent review of the world incidence of IDDM (Karvonen, et al, 1993).

2.1.2. Subject Participation

Determination of the prevalence of IDDM is not a guarantee that all individuals will satisfy the inclusion criteria of the study. Subject participation is determined by the ability to contact subjects and their agreement to participate (Humphreys et al, 1994). Shimakawa et al (1993) and Humphreys et al (1994) both reported that after the exclusion of subjects for various reasons, the anticipated value of the registered diabetic patients, resulted in a smaller than anticipated study sample.

2.1.3. Validation of Dietary Intake Methods

Reported alcohol consumption should be measured and compared using a variety of methods for validation purposes, prior to determining the relationship between alcohol consumption and elevated HbA1c values. The most accurate validation of a dietary assessment method involves directly observing an individual's dietary intake. The application of this method is limited, due to its high cost (Cameron & Van Stavern, 1988). The diet history and food frequency questionnaires (FFQ) are based on the report of the individual, which can not be physically validated by the researcher (Block, 1982). These methods are validated in relative terms, by comparison with similar studies and methods (Block, [1982]; Cypel & Slensinski, [1994]).

2.1.3.1. Diet History

The diet history is an interview process, where the researcher; a trained nutritionist, attempts to elicit the usual dietary pattern intake of the participant (Block, 1982). Diet histories are based on the assessment of an individual's total food intake and 'usual' meal pattern over varying periods of time (Burke, 1947). Advantages include, attainment of long periods of dietary information and the limited effort by the participants, enabling high co-operation rates (Cameron & Van Stavern, 1988).

Effective dietary assessment should allow for under-reporting (Cypel & Slesinski, 1994). Since diet histories measure the 'usual' intake, alcohol consumption will not be reported if the subject considers alcohol an irregular part of their normal intake (Cameron & Van Stavern, 1988). Another disadvantage of the diet history, is it's entire basis on the participants recall and report, where influences such as seasonal fluctuations could play a part in effecting the dietary history given (Cameron & Van Stavern, 1988). Diet histories can be time consuming and the requirement of a trained health professional can increase the cost, hence the diet history may not be applicable in certain situations (Cypel & Slesinki, 1994).

2.1.3.2. Food Frequency Questionnaires

Food frequency questionnaires involve subjects accurately recording their dietary intake for a period usually ranging between three to seven days (Cameron & Van Stavern, 1988). The questionnaire design involves a pre-determined set of responses (Jain, 1989). Questionnaires can be completed in the presence of the participant only (ie: self-administrative) or completed by the researcher (ie: telephone

interview) (Cypel & Sleniski, 1994). There is no special training required in order to implement a questionnaire, they can be implemented by a non-professional (Cypel & Slesinki, 1994). It is a quick, simple and cost effective method which can be completed by participants (Cameron & Van Stavern, 1988).

Questionnaires are just a simple response method, there is no room for other responses by the participant (Block, 1982). Disadvantages occur if the questionnaires are developed without correctly planning all the information that is needed. Accuracy of this method requires high co-operation amongst study participants (Block, 1982); ie to complete their questionnaires correctly.

2.1.3.3. Measuring Alcohol Intake

Rehm & Spuhler (1993) compared the diet history and the telephone FFQ in terms of effectiveness in measuring the estimated alcohol intake per capita. Researchers suggest the diet history to be the more accurate method for measuring alcohol consumption, due in fact to the diet history demonstrating a closer to the estimated alcohol intake per capita, than the telephone FFQ (Rehm & Spuhler, 1993). Additionally, a semi-quantitative FFQ was compared to a 24 hour recall, by Smith et al (1994). The prevalence of under estimating was much higher in the FFQ, indicating that it was not a reliable method to measure alcohol intake.

The design of FFQ in the studies of Rehm & Sphuler (1993) and Smith et al (1994) involved the individual reporting his/her alcohol intake to another person. In

the instance of alcohol consumption, the defined set of responses were categorised into increasing levels. Hesitation may occur if subjects are acknowledging the higher amount of alcohol to another individual, rather than anonymously, as is the case for self-administered questionnaires (Cypel & Slesinski, 1994).

Irregularity in an individual's consumption of alcohol is not catered for in the defined set of responses found in a FFQ. This may result in under reporting (Jain, 1989). Accurately measuring an irregularly consumed item like alcohol, requires the implementation of questionnaires that inhibit any instances of under estimation (Cypel & Slensinski, 1994). Many researchers have used different designs to measure alcohol intake, and these have produced both desirable and undesirable effects (Rehm & Spuhler, 1993).

Rehm & Spuhler (1993), recommended that measures of alcohol intake should be simply constructed to avoid intimidating the subject with excessive numbers of alcohol questions. The researchers surmise that asking subjects about alcohol consumption in various ways, influenced the answering of the second questions, when subjects tried not to produce conflicting results (Rehm & Spuhler, 1993).

The studies of Magarey et al (1993) incorporated alcohol intake questions as a component of a large number of questions. The other questions were unrelated to alcohol intake, with all questions, including those for alcohol intake, asked in a non-threatening way. The researchers believed that by using this method, respondents were not inhibited to answer the questions, therefore promoting the accumulation of a

record of alcohol consumption, close to the actual consumption. (Magarey et al, 1993).

Despite the inherent problems listed previously, FFQ remains the only appropriate and accurate means of measuring alcohol consumption. The structure of a FFQ allows researchers to design responses in order to survey a wide variety of individuals (Cypel & Slesinski, 1994).

Two accurately designed measures of alcohol consumption were developed by the National Heart Foundation of Australia (NHF) (Risk Factor Prevalence Study Management Committee, 1990) and the Diabetes Control and Complications Trial (DCCT) (DCCT Research Group, 1986). The NHF Risk Factor Prevalence Study (RFPS), investigated the frequency of drinking and the quantity of alcohol consumed (Risk Factor Prevalence Study Management Committee, 1990), making it the most accurate alcohol intake assessment method of the two studies. The FFQ in the DCCT was not as well designed as the NHF questionnaire, as the amount of alcohol consumed by each individual was specified with only the frequency of alcohol consumed being measured (DCCT Research Group, 1986).

2.1.4. Alcohol Intake Trends

The third survey of the RFPS (Risk Factor Prevalence Study), found that 87 percent of non diabetic men and 75% percent of non diabetic women reported drinking alcohol (Risk Factor Prevalence Study Management Committee, 1990). Similarly, the Australian Bureau of Statistics, reported that 74 percent of non diabetic males and 52

percent of non diabetic females drank alcohol (Australian Bureau of Statistics, 1992). Both surveys used a diet record to assess the dietary intake of subjects. The ABS gathered its data through the use of a three day diet record, whereas a seven day diet record was implemented by the RFPS.

Close et al (1992) analysed the diets of diabetic individuals by using a seven day diet record and a comprehensive diet history. Close et al (1992) utilised a comprehensive diet history, widening chance of result of alcohol intake being reported. Data gathered indicated that 77 percent of IDDM males consumed alcohol, compared to 66 percent of IDDM females. In contrast, Humphreys et al (1994) utilised a three day diet record, reporting, 60 percent of IDDM men and 38 percent of IDDM females consumed alcohol, with a lower consumption of alcohol for both genders, in the 18-24 age group. Differences in the time span used in the diet record of these two studies (Humphreys et al, [1994]; Close et al, [1992]), could have promoted the varying the percentile results (Block, 1982).

2.1.4.1. Frequency

Reports from the RFPS indicate that males tended to be the most frequent drinkers, with individuals drinking alcohol at least once a week (Risk Factor Prevalence Study Management Committee, 1990). 'Regular' drinking amongst both males and females was more common in the older age group, whereas the younger age group (20-29 years old) were more likely to be 'Occasional' drinkers (Risk Factor Prevalence Study Management Committee, 1990). Frequency of 'Heavy' drinking (12%) appears to be higher amongst younger people (20-24 years), than the drinking

of the older age group (greater than 50 years) (Risk Factor Prevalence Study Management Committee, 1990). This observed pattern was exaggerated amongst the female population. Twenty percent of women drinkers aged 20-24 years were 'Heavy' consumers compared with around two percent of women older than 50 (Risk Factor Prevalence Study Management Committee, 1990).

Information pertaining to the frequency of alcohol consumption amongst the diabetic population is difficult to obtain, as research in this area typically involves researchers measuring alcohol in terms of volume (Humphreys et al, [1994] ; Close et al, [1992]). The three day or seven day diet records used in such studies specify the amount of alcohol an individual consumes for that period of time. A true representation of alcohol frequency would need to be a retrospective measure, namely a food frequency questionnaire, which asks how often participants consumed specified amounts of food items during the preceding year (Jain, 1989).

2.1.4.2. Quantity

Statistical analysis of the reported alcohol consumption from the RFPS, demonstrated that on a day when alcohol was consumed, men tended to drink more than women (Risk Factor Prevalence Study Management Committee, 1990). Eighteen percent of men consumed 'Heavy' amounts of alcohol (5-8 drinks), compared to women (six percent) (Risk Factor Prevalence Study Management Committee, 1990).

Humphreys et al (1994) did not report on the amount of alcohol that the diabetic participants reported in the three day diet record. Close et al (1992), were the

only researchers to date that have discussed the importance of the quantity of alcohol intake. The researchers report that people with diabetes tend to have an average daily alcohol intake of 12g for both men and women (Close et al, 1992). Only two men recorded average daily intakes greater than 30g, with three women recorded intakes greater than 20g. The mean percentage of the total energy derived from alcohol was 4.2 percent in the men and 3.6 percent in the women who consumed alcohol.

2.1.5. Recommended Levels of Alcohol Intake

Individuals with IDDM are recommended to consume only a moderate intake of alcohol (ADA, 1995). The study of Nikkila & Taskinen (1975) defined 'moderate' intake as 40 grams of alcohol per day. Faccihini et al (1994), defined 'moderate' alcohol intake as 1-3 alcoholic drinks per day, equivalent of 10-30 grams of alcohol (Zeman, 1991). Recent recommendations for alcohol intake amongst people with diabetes, supports this classification, suggesting that two or less alcoholic beverages should be consumed with food or shortly before (ADA, 1995). The definition of moderate intake is important, for the British Nutrition Subcommittee proposed a relationship of progressively increasing morbidity and mortality, directly related to an average intake greater than 40g/day amongst females and 60g/day within the male population (Connor & Marks, 1985).

2.2. Relationship between Alcohol Intake and Blood Glucose Control

The accurate measurement of the relationship between alcohol consumption and blood glucose control within diabetic and non diabetic populations, requires consideration of the following parameters:

- normal distribution of blood glucose control (HbA1c values) for both the diabetic (Peveler et al, [1993] ; Shimakawa et al, [1993]) and non diabetic population (DAA, 1990) (**Section 2.2.1.**),

- relationship between alcohol consumption and HbA1c values (Peveler et al, [1993] ; Shimakawa et al, [1993]) (**Section 2.2.2.**) and,

- determining if the effects of alcohol consumption on blood glucose levels involves a spectrum of impairment of glucose tolerance to no effect to enhancement of glucose tolerance; between diabetic and non diabetic participants (Marks, 1978) (**Section 2.2.3.**)

2.2.1 Distribution of HbA1c Values

The Dietitians Association of Australia (DAA, 1990), have described standard levels of measurement for total glycosylated haemoglobin (HbA1) measurement. The DAA described 'ideal' levels as less than 8 percent, 'good' ranging between 8-10 percent, 'average' as greater than 10 percent and 'poor' greater than 12 percent (DAA, 1990).

Distribution of HbA1c amongst individuals with diabetes was discussed in the studies of Peveler et al (1993) and Shimakawa et al (1993). Both studies defined blood glucose control in the glycosylated haemoglobin assay, with differing

determining methods. Peveler et al (1993) utilised the HbA1c assay, whereas the Shimakawa et al (1993) used the HbA1 measure, which is not as precise or distinct as the HbA1c. Peveler et al (1993) described that in 127 diabetic outpatients in Oxford, UK, the HbA1c values ranged between 7 percent and 18.2 percent. This observation was supported by the results from the 162 participants in the study by Shimakawa et al (1993), which reported the HbA1c distribution between 7 percent to 17 percent. These values are higher than the 'ideal' values recommended by the DAA.

2.2.2. Alcohol Consumption and HbA1c Values

Peveler et al (1993) found a significant value between alcohol consumption and HbA1c. The researchers determined that the metabolic control of an individual was affected with the consumption of alcohol amongst the male subjects (Peveler et al, 1993). Shimakawa et al (1993) found the association between alcohol intake and glycaemic control to be similar between those who consume 5g of alcohol or more daily and those who consumed less than 5g daily. Mean HbA1c and mean HbA1 was found to be similar in both groups, despite gender differences between males and females.

Statistical analysis of the HbA1c value differed amongst studies. Prior to analysis with level of alcohol consumption, Shimakawa et al (1993) divided the HbA1c into quartiles greater than 10 percent. Peveler et al (1993) divided the HbA1c values around the median. As the median is a physical mean, this does not give an idea of how this relationship relates to the recommendation for HbA1c values, in order to determine blood glucose control. The dietary methods used were also different. The

study by Peveler et al (1993) examined dietary intake by a semi-structured questionnaire, whereas Shimakawa et al (1993) involved the implementation of a food frequency questionnaire. The food frequency questionnaire may lead to error in alcohol measurement, whereas a semi-structured interview allows for a more personal interview, hence enhancing the attainment of information. The use of a control group was only utilised in Peveler et al (1993). Shimakawa et al (1993) did not investigate the relationship between glucose control and alcohol consumption with a control group. These areas could have been the reason for the different results of these two studies.

Enhancing the knowledge of the relationship between alcohol consumption and blood glucose control, may be gained through the investigation of the immediate effects of blood glucose levels.

2.2.3. Alcohol Consumption and Elevated Blood Glucose Levels

Traditionally, research in the area of alcohol consumption within IDDM individuals, has focused on the occurrence of hypoglycaemia (Franz, 1990). However, when considering blood glucose control, the focus is more towards the possible hyperglycaemic effects of alcohol consumption (Franz, 1990).

Significant hyperglycaemia after the consumption of alcohol has been observed in animal experimentation (Marks, 1978). However, this research was based on excessive, lethal doses of alcohol and animal experimentation (Marks, 1978), hence the

findings can not be rightfully generated to humans. In conclusion to these investigations, it has been commonly proposed that alcohol contributes to hyperglycaemia and glucose intolerance (Franz 1990). The confusion surrounding this area of research, is demonstrated by the absence of no conclusive evidence on the role of alcohol intake towards the inducement of significant hyperglycaemia or markedly impaired glucose tolerance (Franz, 1990).

2.2.3.1. Mild Impairment in Glucose Tolerance

Feingold & Siperstein (1983) described three cases where individuals' consuming large amounts of alcohol, developed elevated blood glucose levels and were diagnosed with IDDM. The levels of alcohol consumption for one subject reputed to be least one six pack of beer a day for several months (approximately 90 g of alcohol/day). Once these three subjects begun treatment for diabetes (thus abstaining from alcohol intake), the symptoms of diabetes disappeared. The mechanisms for excessive consumption of alcohol precipitating the occurrence of diabetes is unknown, as the subjects did not have any signs or symptoms of pancreatitis (Feingold & Siperstein, 1983). The onset of diabetic symptoms may have been due in part to the individuals' genetic disposition to IDDM (Feingold & Siperstein, 1983), triggered by excessive alcohol consumption (Franz, 1990).

Dornhorst & Ouyang (1971) examined the effects of a 'moderate' alcohol dose amongst six healthy young women aged between twenty to twenty-two years. After a

12 hour fast, each subject was given orally a dose of alcohol, equivalent to two glasses of sherry (20g/alcohol). Over the following 120 minutes blood samples were taken at ten minute intervals. The researchers described a moderate rise in blood glucose after alcohol ingestion and a higher-than-normal response to glucose challenge (Dornhorst & Ouyang, 1971) .

The description of a significant reduction in glucose utilisation rate via impairment of glucose tolerance was also reported in the research of Yki-Jarvinen & Nikkila (1985). The investigators studied seven healthy male individuals. Following a one hour fast, the seven subjects orally ingested an alcoholic drink (0.67g/kgBW). Ten minutes after the initial dose subjects were constantly infused intra-venously with alcohol (0.33g/kgBW) for a period of 200 minutes. Following this subjects were infused with glucose, during this time plasma, insulin and glucose values were measured. Elevation of the plasma insulin to a high physiological level during alcohol ingestion and infusion, prompted the researchers to conclude that the rate of glucose metabolism was lower in those who consume alcohol (Yki-Jarvinen & Nikkila, 1985). When high insulin and normal blood glucose levels were measured, the majority of infused glucose (or alcohol) was taken up by peripheral tissues (Yki-Jarvinen & Nikkila, 1985). The liver was involved in a small amount of glucose uptake only. Development of glucose tolerance influenced by alcohol could quite possibly result from the reduced glucose uptake by peripheral tissues, hence the resultant decrease of glucose metabolism (Yki-Jarvinen & Nikkila, 1985).

A large scale population study involving non-invasive retrospective analysis of individual alcohol intake (Gerard et al, 1977), also found a significant relationship between the amount of alcohol that healthy individuals' consumed, compared to the elevation of their blood glucose levels. Gerard et al (1977) investigated the relationship between the alcohol-consumption habits of a large population and their serum glucose levels. The information pertaining to alcohol intake was obtained by two questions in a self-administered health questionnaire specifying the frequency and amount of alcohol consumed. The results indicated that amongst individuals who consumed 6-8 drinks per day (60-80 grams of alcohol/day) their serum glucose was elevated (Gerard et al, 1977).

O'Keefe and Marks (1977) also studied the effects of alcohol on the blood glucose and plasma insulin levels. Following a morning fast, ten IDDM subjects were given a cocktail at roughly ten minute intervals, of either gin and regular tonic, gin and diet tonic or just tonic, for the period of one hour. The total amount of alcohol consumed was 50 grams. A rise in plasma blood glucose was noted immediately after ingestion of alcohol within 0 to 60 minutes, gradually reducing over the remaining hour. Overall, the researchers found that the combination of glucose (regular tonic) and alcohol (gin) produced a more severe hypoglycaemic response, through the production of greater insulin levels, than a drink containing only alcohol (gin) (O'Keefe & Marks, 1977). This suggested only a mild impairment in glucose tolerance of IDDM subjects, after the consumption of alcohol (O'Keefe & Marks, 1977).

Corroborating the incidence of a mild impairment of glucose tolerance with alcohol intake was the research of Avogaro et al (1983). Five IDDM subjects were compared to five non diabetic subjects. Two different study diets were administered to all subjects, one being 35 percent of total energy intake as wine, the other containing no alcohol at all. Insulin and glucose levels were monitored during the course of this study. The researchers found that amongst IDDM subjects, there was relatively reduced insulin levels with a consumption of alcohol, and that the daily mean glucose levels for people who drink alcohol were similar to those during the diet without alcohol (Avogaro et al, 1983). Even though after the ingestion of a meal, the postprandial peak glucose levels of IDDM subjects values were higher during the alcoholic diet than during the diet without alcohol (Avogaro et al, 1983). The non diabetic subject who consumed the diet with alcohol experienced lower blood glucose levels of both the daily mean and the postprandial peak values. Avogaro et al (1983) concluded that the observation of the controls did not support the findings of Dornhorst & Ouyang (1977) of alcohol inducing impairment of glucose tolerance in non diabetics. Avogaro et al (1983) proposed that the moderate impairment of peripheral disposal of glucose through the increased insulin requirement in IDDM subjects occurred after the ingestion of alcohol, leading to a mild impairment of glucose metabolism in diabetics.

2.2.3.2. Enhancement or no effect on glucose tolerance

Mayer et al (1993) examined the effects of 'usual' alcohol intake on the circulating insulin levels of 352 twin pairs of non diabetic women. Alcohol intake during the preceding month was measured via a self-administered FFQ. Mayer et al

(1993) found that the adjusted mean levels of both fasting and post load insulin were lower among women who reported higher alcohol intake (between 10 g/wk and 20 g/day). The greatest difference occurred in the comparison between those that did not drink and light drinkers (Mayer et al, 1993).

Facchini et al (1994) found lower plasma glucose and insulin concentrations amongst consumers of 'light-to-moderate' amounts of alcohol (10-30 grams of alcohol/day) associated with enhanced insulin mediated glucose uptake. The research design involved 40 non diabetic subjects comprising 20 light-to-moderate drinkers and 20 non drinking controls matched to the alcohol consumers for age and sex. Subjects fasted overnight and were administered an oral glucose challenge after the fast. Plasma glucose and insulin concentrations were determined before, and at 30 minute intervals till 180 min, after the glucose challenge. Researchers found that the plasma glucose and insulin concentration before and after the oral glucose challenge were lower in the 'light-to-moderate' drinkers (Facchini et al, 1994). Hence, they felt that these individuals are relatively more insulin sensitive and have lower plasma insulin levels than do non drinkers (Facchini et al, 1994).

Walsh & O'Sullivan (1974) studied the effects of three glasses of spirits (30g of alcohol), on the glucose control of twenty diabetic subjects. Amongst the seven IDDM subjects, the mean plasma glucose levels after the ingestion of alcohol was found to be lower than the non diabetic controls and after the IDDM subjects has consumed glucose, indicating enhancement of glucose uptake (Walsh & O'Sullivan, 1974). The researchers suggest that intake of moderate doses of alcohol, do not

immediately affect glucose control and alcohol in moderation is not harmful to health within the diabetic population (Walsh & O'Sullivan, 1974).

The effect of alcohol and glucose disposal, insulin and glucagon secretion was examined by McMonagle & Felig (1975). This study involved the comparison of a diabetic population with a non-diabetic population. The ages of the diabetic population ranged between 32 and 58 years whereas the control subjects were aged between 19 and 28 years (McMonagle & Felig 1975). The diabetic population observed in this study were mildly diabetic, that is none of the subjects were on insulin therapy, or had received insulin in the last twelve months. Every hour for four hours, the diabetic subjects consumed either 60 ml (60 grams) of alcohol or 60ml of low calorie soda. Both beverages were mixed with 200 ml of water. The glucose levels show that ethanol had no effect on the basal glucose concentrations. Glucose levels were 40-80 mg lower in the ethanol group at 90-180 min after glucose ingestion, indicating that ethanol inhibited the blood glucose rise following the ingestion of glucose. The researchers felt that this study was unique as it attempted to reproduce 'usual' alcohol intake consumption rates of individuals, whereas other research has involved ingestion of large amounts of alcohol (Avogaro et al, 1983).

Koivisto et al (1993) found that moderate alcohol intake with dinner had no substantial effect on glucose levels. The subjects received an aperitif (13g of alcohol), 400ml of red wine (33g of alcohol) and 40 ml of cognac (13g of alcohol) with dinner for a period of two days. A minimal elevation of blood glucose did occur amongst the IDDM subjects, but the researchers felt that this was not substantial. No clear

relationship emerged from the study, with subjects reported as having variable blood glucose levels.

In summary, the accurate measurement of alcohol consumption within an diabetic population of a region needs the following considerations:

- Recruitment of all possible diabetic individuals in the area
- the choice of a dietary method which best enhances the individual to accurately report their alcohol intake

The role of alcohol consumption on the blood glucose control of the IDDM subject is not conclusive regarding either the impairment or enhancement of glucose tolerance. Hence it is difficult to assess the impact of alcohol on HbA1c levels.

Chapter 3. Methods

Chapter 3. Methods

This study is part of a research group. The research group comprises six Master of Science candidates and one PhD candidate. Each individual MSc study is a subsidiary branch of the major PhD study. The method of data collection is uniform across all studies, hence data collected were pooled for the use of all members of the research group. The aim of this particular study was to investigate the influence of alcohol intake upon the glucose control of individuals with IDDM.

The study was approved by the University of Wollongong Human Experimentation Ethics Committee. Consent was obtained from participants via a Consent Form (refer Appendix 1), which also explained their rights as a participant.

3.1. Accurate Measurement of Alcohol Intake

3.1.1 Prevalence of IDDM

A list of 71 subjects was obtained from the Diabetes Education and Information Unit in Wollongong. Subjects were contacted by letter, requesting their participation in the study. They were asked to bring along a friend, who did not have diabetes and was of the same age, sex and socioeconomic status. These became the control group.

3.1.2. Subject Participation

Subjects were included in the study if they were individuals of the Illawarra area, aged between 18 to 30 years and had been diagnosed with IDDM in the last ten

years. Controls were included in this study if they were friends of a subject who were matched for age, sex and socioeconomic status. Subjects were excluded if they were less than 18 years of age or greater than 30 years of age, if they did not have diabetes or if they had non-insulin dependent diabetes mellitus (NIDDM).

After admission to the study, the subjects were required to attend an interview session. Approximately two hours was required for the researchers to collect the information relevant to each study. Only the methods pertinent to this study will be described.

3.1.3. Dietary Intake Methods

The dietary methods used in this study were a modified Burke Diet History, and the self-administrated RFPS (refer Appendix 2a) and the DCCT FPQ (refer Appendix 2b.) questionnaires. Participant's diet history was reported to the research group members, who were experienced in nutritional counselling. The self-administrated questionnaire items were completed in the presence of a researcher, in case of any queries. After the information obtained by the diet history had been converted to accurate quantities, it was analysed on the nutrient analysis software package, Diet 1 (Xyris Software), using the 'Nut-tab' 1992 database. Alcohol consumption values of all dietary methods were compared to cross-validate the observed results. Previous reports on the results of the RFPS were used to validate the value obtained by the researchers.

3.1.4. Alcohol Intake Trends - Frequency

The alcohol intake items were incorporated into the Practical Issues of IDDM questionnaire (RFPS items) (refer Appendix 1a.). The frequency of alcohol consumption was asked by question eight of the Practical Issues of IDDM Questionnaire. This question asked individuals “How often do you drink alcohol?”. The coded response was converted into categories of frequency; ie ‘Never’, ‘Occasional’ or ‘Regular’ (refer Appendix 3). Individuals responding to “I don’t drink alcohol”, were classified ‘Never’, ‘Occasional’ drinkers indicated they consumed alcohol “Less than once a week”, whereas ‘Regular’ drinkers indicated they consumed alcohol at least once a week. The trends of these frequency categories were also used to descriptively describe the sample. The number of individuals who consumed alcohol were determined by their allocation into a frequency category, with the ‘Occasional’ and ‘Regular’ drinkers being defined as those who consumed alcohol.

3.1.4.1. Quantity

Quantity of consumed alcohol was addressed by the question “On a day when you drink alcohol, how many drinks do you usually have?” (refer Appendix 1a). The number of drinks responded was converted to the categories ‘None’, ‘Light’, ‘Moderate’ and ‘Heavy’. The conversion of quantity of drinks to grams of alcohol was based on the knowledge that one alcoholic drink is equivalent to ten grams of alcoholic beverage (Zeman, 1991). The categories were based on the recommended levels of alcohol consumption for diabetes (ADA, 1995). Consumption values over 40 grams of alcohol (“5-8 drinks” or greater), was considered to be ‘Heavy’. ‘Moderate’ consumption subjects indicated their consumption level to be “3 or 4 drinks”

(approximately 35 grams of alcohol), whereas 'Light' drinkers were those who consumed approximately 15 grams of alcohol ("1-2 drinks"). This was also converted into categories to aid the statistical analysis of these (refer Appendix 3.). The trends were also used in descriptive analysis.

3.2 Relationship between Alcohol Intake and Blood Glucose Control

3.2.1. Glycosylated Haemoglobin Values

The attainment of a non fasted, venous blood sample was performed at the Wollongong Hospital Outpatient Clinic. The HbA1c assay was performed by high performance liquid chromatography and was recorded in levels of percentage (Gonen et al, 1977).

3.2.2. Alcohol Consumption and HbA1c values - comparing diabetic and non-diabetic participants

The comparison of the relationship between the amount of alcohol consumed (in grams) and HbA1c values within the diabetic and controls samples, was carried out by means of a fit line test, available in the JMP 3.0 statistical package.

3.2.3 Influence of the Frequency and Quantity of Alcohol Consumption on the HbA1c Value

The frequency categories (refer 3.1.4.) were statistically compared to the HbA1c values by applying an ANOVA test, with the JMP 3.0 statistical computer software package. This was performed to test the significance between the amount of alcohol consumed and the values of HbA1c. The relationship between HbA1c and the amount of alcohol consumed (refer 3.1.4.1) was also compared by an ANOVA test on the JMP 3.0 statistical computer software package.

Chapter 4. Results

Chapter 4. Results

4.1. Accurate Measurement of Alcohol Intake

4.1.1. Prevalence of IDDM

The register at the Wollongong Diabetes Education Information Unit, identified 71 individuals who had been diagnosed with diabetes in the last ten years. After addressing the selection criteria, the anticipated amount of IDDM subjects totalled 67 individuals, aged between 20 - 30 years.

4.1.2. Subject Participation

Diabetic individuals satisfying the inclusion criteria did not automatically become study participants. Table 4.1 illustrates the reasons behind the exclusion of individuals from this study. Within the control sample, nine subjects became part of this study through their acquaintance with the diabetic subjects. The remaining six controls were personally recruited by the researchers.

Table 4.1 Subject Participation

	Study Participants	Non Participants
Included Subjects	21 IDDM subjects	7 IDDM cancelled appointments 3 IDDM HSC students 12 IDDM not interested 10 IDDM moved away 14 IDDM unable to contact
Excluded Subjects		3 NIDDM 1 non diabetic
Total	21	50

4.1.3. Validation of Diet Intake Methods

Tables 4.2 & 4.3 reflects the comparison of the three dietary methods used in this study. 'Practical issues' states answers from the questions in Appendix 1a, 'DCCT' is the response from the questions from Appendix 1b, whereas 'Diet History' is percentage of alcohol contributing to the total energy of the diet. All three methods appeared to be associated amongst those who did not consume alcohol, and those with alcohol 'Regular' consumption. Results of the diet history for individual's with 'Occasional' alcohol consumption, was independent of both questionnaire results.

Table 4.2. Correlation of Dietary Intake Methods amongst subjects

Practical	Issues	DCCT				Diet History
Frequency	Quantity	Beer	Spirits	Liqueur	Wine	% Alcohol
<i>Diabetics</i>						
Occasional	Moderate	1-3 a mth	1-3 a wk	Never	Never	0
Occasional	Heavy	Never	Never	Never	1-3 a mth	0
Occasional	Light	Never	Never	Never	Never	0
Occasional	Moderate	Never	1-3 a mth	Never	1-3 a mth	0
Occasional	Moderate	Never	Never	Never	Never	0
Never	None	Never	Never	Never	Never	0
Occasional	Heavy	Never	1-3 a wk	Never	Never	0
Never	None	Never	Never	Never	Never	0
Never	None	Never	Never	Never	Never	0
Regular	Moderate	4-6 a wk	1-3 a wk	1-3 a mth	Daily	11
Regular	Heavy	1-3 a mth	1-3 a mth	Never	1-3 a mth	0
Occasional	Light	1-3 a mth	Never	Never	1-3 a mth	0
Regular	Moderate	1-3 a mth	Never	Never	Never	2
Regular	Light	Daily	Never	Never	Never	5
Occasional	Heavy	1-3 a wk	1-3 mth	1-3 a mth	1-3 a mth	0
Occasional	Light	1-3 a mth	Never	Never	Never	0
Occasional	Heavy	Never	1-3 a mth	Never	a	0
Never	None	Never	Never	Never	Never	0
Occasional	Heavy	1-3 a mth	Never	Never	Never	0
Occasional	Moderate	1-3 a mth	1-3 a mth	Never	1-3 a mth	0
Regular	Light	a	a	a	a	0
<i>Controls</i>						
a	a	1-3 a wk	1-3 a mth	Never	Never	0
Regular	Moderate	Never	1-3 a mth	Never	Never	0
Occasional	Moderate	Never	1-3 a mth	Never	Never	0
Regular	Light	1-3 a wk	Never	Never	Never	0
Regular	Heavy	4-6 a wk	a	a	a	3
Occasional	Heavy	1-3 a wk	a	a	Never	0
Occasional	Light	1-3 a mth	Never	Never	Never	0
Regular	Heavy	4-6 a wk	Never	Never	Never	2
Occasional	Moderate	1-3 a mth	1-3 a mth	Never	Never	0
Regular	Moderate	1-3 a wk	1-3 a mth	1-3 a mth	Never	0
Never	a	Never	Never	Never	Never	0
Regular	Moderate	1-3 a mth	Never	Never	1-3 a mth	0
Occasional	Heavy	1-3 a mth	1-3 a mth	Never	Never	0
Occasional	Light	Never	Never	Never	Never	0
Never	a	Never	Never	Never	Never	0

Note: Never = 1-3 times a year or never.

a = item not answered

4.1.4. Alcohol Intake Trends

Eighteen of the 21 diabetic subjects (86%) consumed alcohol, on either a 'Regular' or 'Occasional' basis. Amongst the control (non diabetic) population, eleven were alcohol consumers, representing 91.5 percent of the control group. Within each category of drinkers or non drinkers, for both the diabetic and non diabetic samples, males were of the highest attendance.

4.1.4.1. Frequency

Using a percentile comparison basis, the control subjects drank more frequently than the diabetic subjects, as a higher percentage of controls was illustrated in the 'Regular' category. 'Occasional' drinking was the most frequent amongst both the diabetic and control subjects.

Table 4.3 Frequency of Alcohol Consumption amongst subjects

Subjects	Never	Occasional	Regular	Total
<i>Diabetic</i>				
Males	3 (14%)	8 (38%)	4 (19%)	15 (71%)
Females	0 (0%)	6 (29%)	0 (0%)	6 (29%)
Total	3 (14%)	14 (67%)	4 (19%)	21 (100%)
<i>Control</i>				
Males	2 (18%)	5 (46%)	4 (36%)	11 (79%)
Females	0 (0%)	2 (67%)	1 (33%)	3 (21%)
Total	2 (14%)	7 (50%)	5 (36%)	14 (100%)

4.1.4.2. Quantity

A higher proportion of male control subjects drank drinking the larger amounts of alcohol at each occasion. Again the diabetic and controls tended to drink more alcohol than abstain from alcohol

Table 4.4. Amount of Alcohol Consumed amongst subjects

Subjects	None	Light	Moderate	Heavy	Total
<i>Diabetic</i>					
Males	3 (14%)	4 (19%)	4 (19%)	4 (19%)	15 (71%)
Females	0 (%)	1 (5%)	2 (10%)	3 (14%)	6 (29%)
Total	3 (14%)	5 (24%)	6 (29%)	7 (33%)	21 (100%)
<i>Control</i>					
Males	2 (18%)	2 (18%)	3 (28%)	4 (36%)	11 (79%)
Females	0 (0%)	1 (33%)	2 (67%)	0 (0%)	3 (21%)
Total	2 (14%)	3 (21%)	5 (36%)	4 (29%)	14 (100%)

4.2 Relationship between Alcohol Intake and Blood Glucose Control

4.2.1 Distribution of Glycosylated Haemoglobin Values

The distribution of HbA1c values are compared to standard values to interpret the blood glucose control of each individual. The distribution of the HbA1c values amongst diabetic subjects is illustrated in Figure 4.1. Values ranged between 7.2 percent and 11.5 percent, with a mean value was 9.2 percent and standard deviation of 1.81. Values between 7.5 percent and 8.4 percent totalled six subjects, the highest frequency reported. No controls produced any elevated HbA1c levels. Values actually measured ranged between 5.4 percent and 6.4 percent with a mean of 8.3 percent and standard deviation of 6.51.

Figure 4.1 Distribution of HbA1c values amongst diabetic subjects

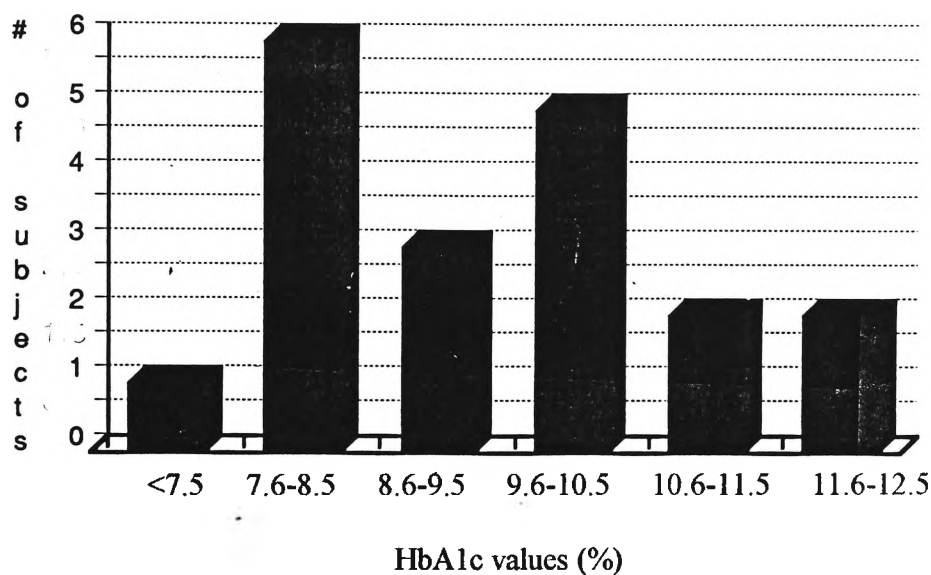
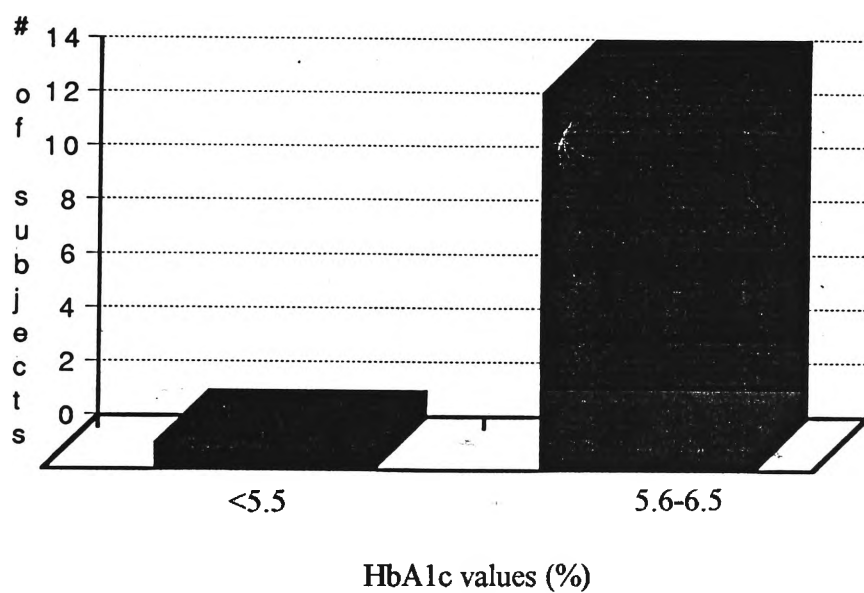


Figure 4.2 Distribution of HbA1c values amongst non diabetic subjects



4.2.2 Alcohol Consumption and HbA1c values - comparing diabetic and non diabetic participants

A significant result ($p < 0.05$) was reported in the relationship between HbA1c and the amount of alcohol consumed in grams amongst diabetic subjects, as illustrated by Figure 4.3. No significance was reported amongst the control group. This indicates that the amount of alcohol consumed is more likely to effect the HbA1c values of a diabetic individual, as opposed to a non diabetic individual.

The significance of the following results are due to a statistical anomaly. An individual consumed more than 200 grams of alcohol per session, at least 95 grams above any other subject. The particular individual is defined as a person with high HbA1c values (11.5%), and is a 'Regular' drinker, drinking approximately 200g of alcohol on a daily basis. Removal of the outlying point the aberrant individual substantially demotes the significance of these results as shown in Figure 4.4.

Figure 4.3 Determination of Significant Values between control and diabetic subjects

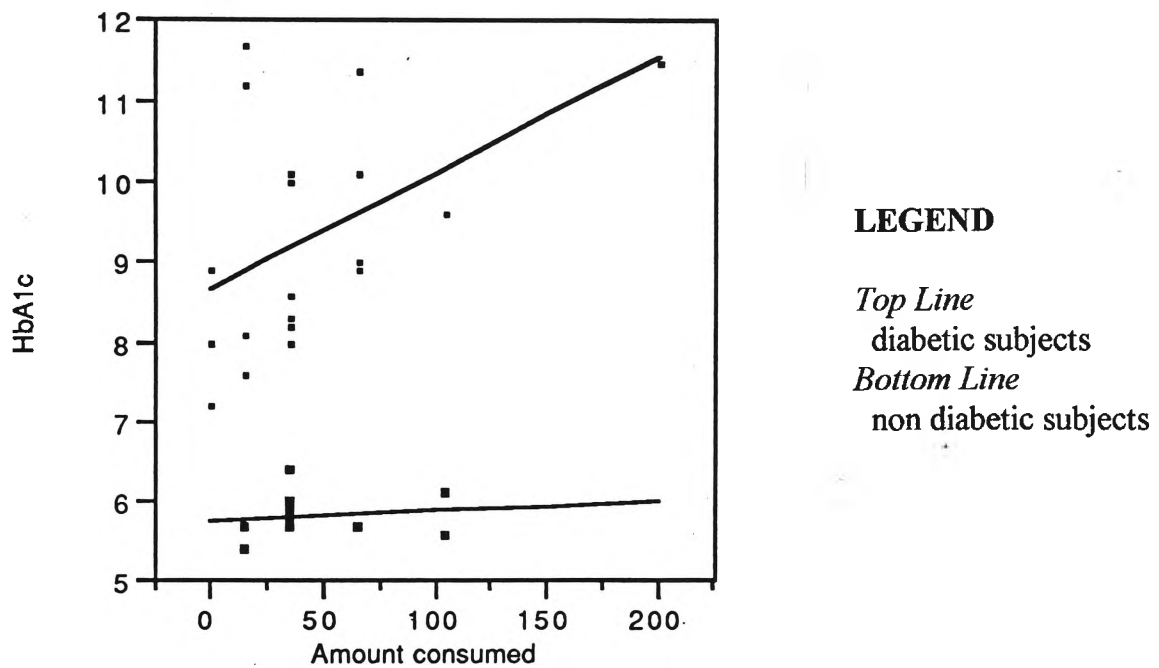
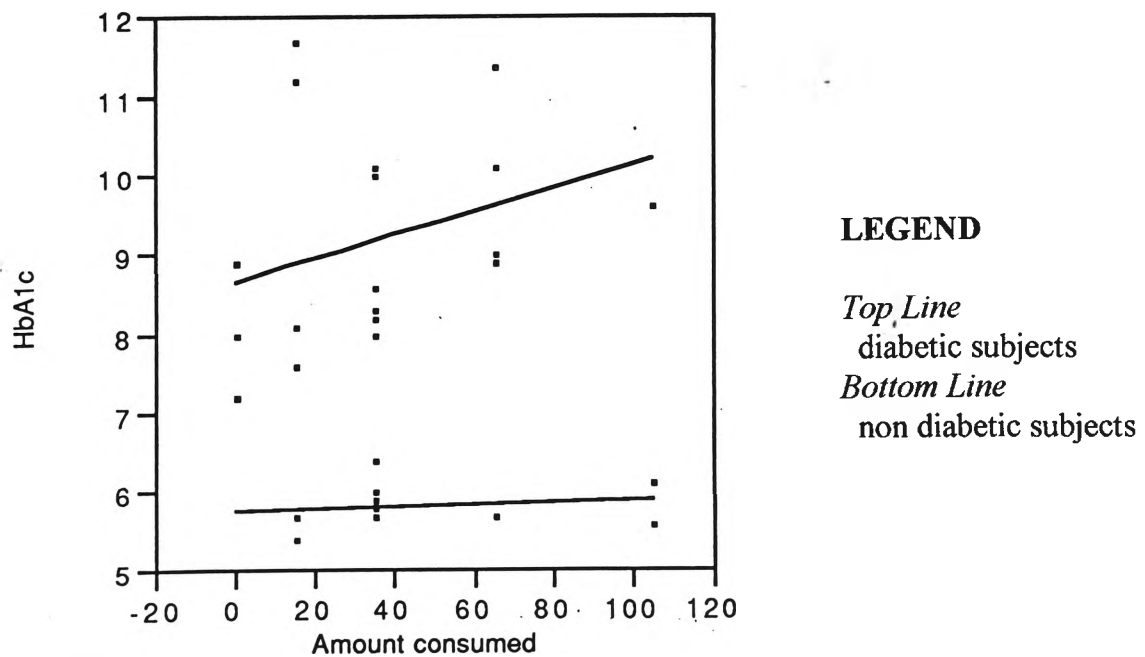


Figure 4.4 Second analysis of significant values between control and diabetic subjects



4.2.3. Influence of the frequency and quantity of alcohol consumption on the HbA1c value

Figures 4.5 and 4.6 depict the relationships between HbA1c and frequency of alcohol consumption amongst diabetics and controls. No firm conclusion or significant values may be drawn from these diagrams, although results indicate a minor positive trend between elevated HbA1c and frequent alcohol consumption. Amongst the quantity of alcohol consumed, the only noticeable trends are those exhibited by diabetic individuals with elevated HbA1c levels who consume 'Heavy' amounts of alcohol (refer Figures 4.7 & 4.8).

Figure 4.5 Relationship between HbA1c values and frequency of alcohol consumption amongst diabetic subjects

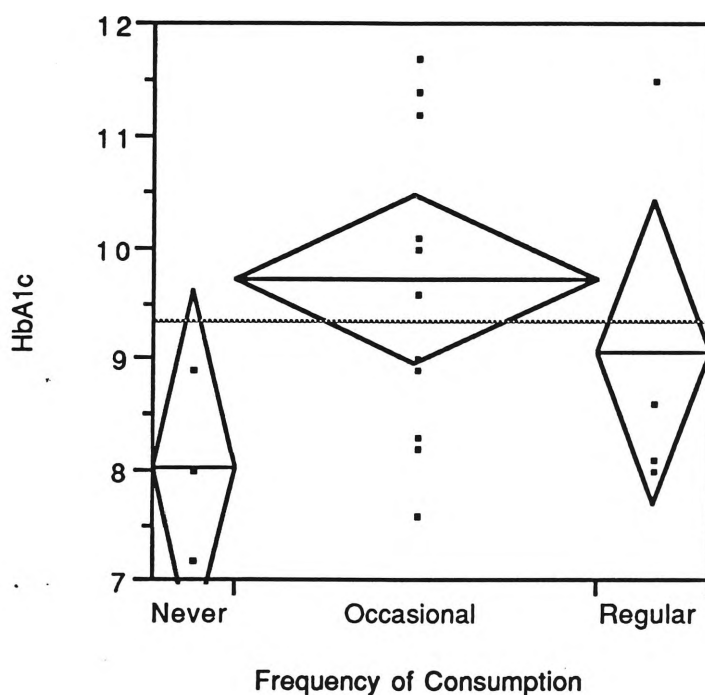


Figure 4.6 Relationship between HbA1c values and alcohol frequency amongst control

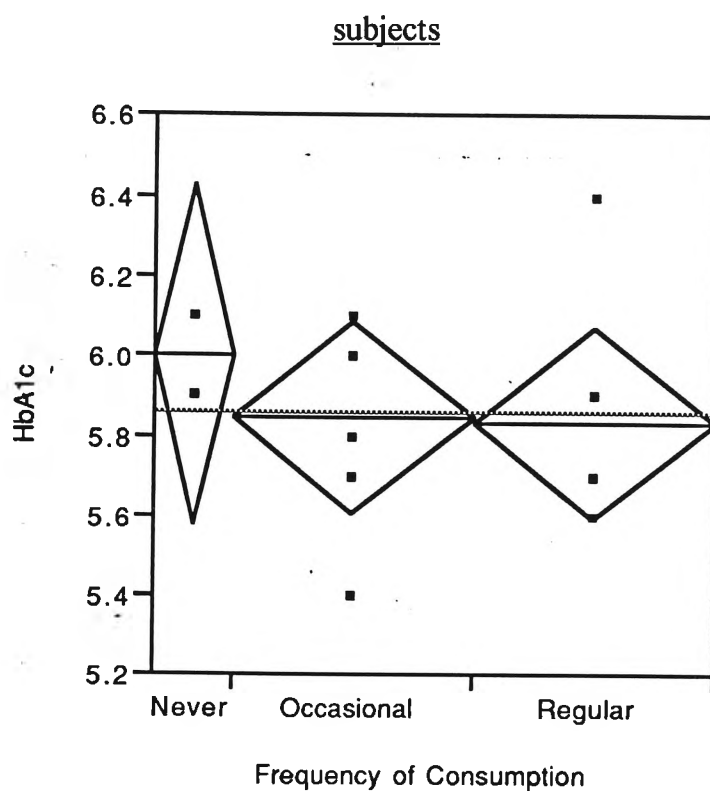


Figure 4.7 Relationship of HbA1c values and amount of alcohol consumed amongst

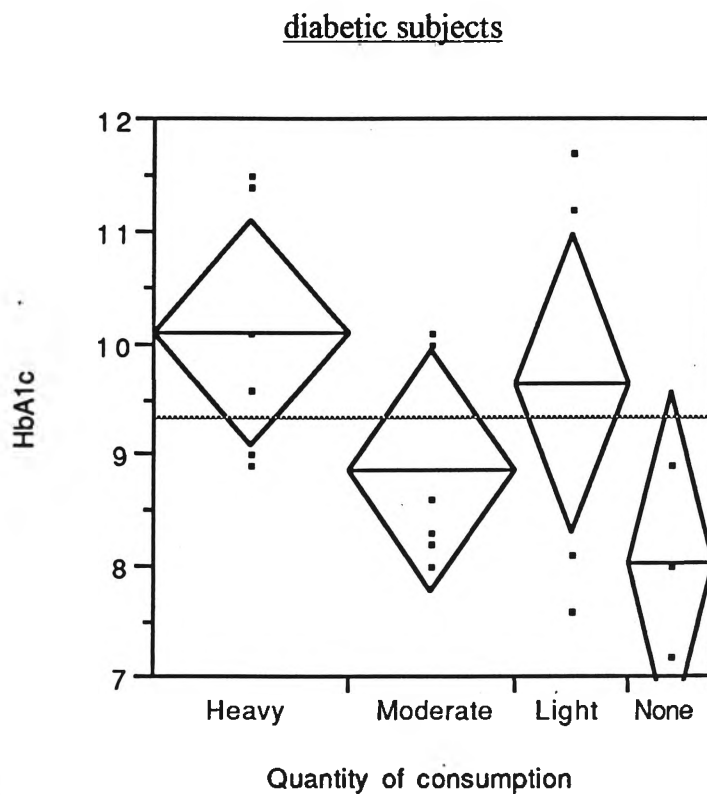
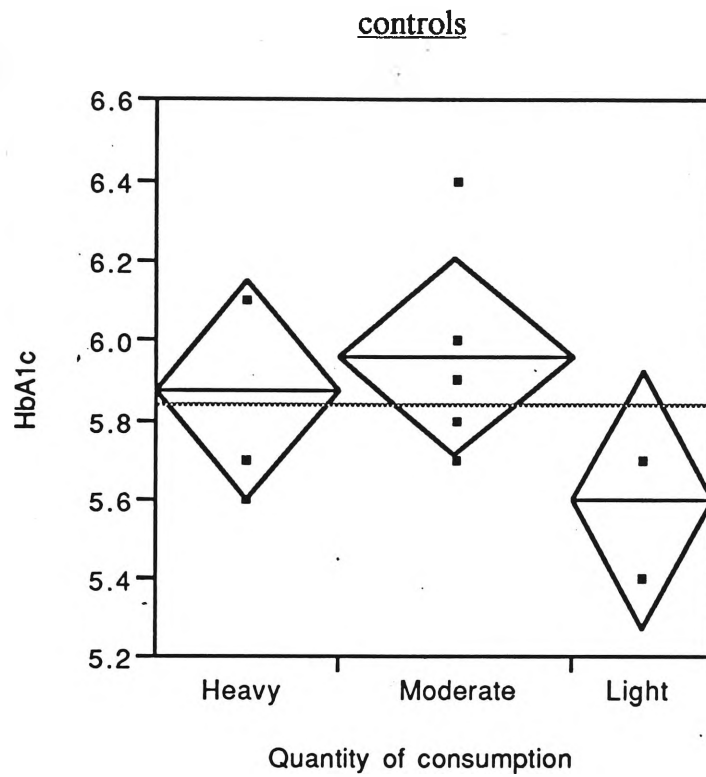


Figure 4.8 Relationship of HbA1c values and amount of alcohol consumed amongst



Chapter 5. Discussion

Chapter 5. Discussion

5.1. Accurate Measurement of Alcohol Intake

5.1.1. Prevalence of IDDM

The responses from 67 individuals in the Illawarra region were used in this study. This sample size is a fair representation the actual diabetic population in the Illawarra region, based on the research of Scott & Brown (1991). There are two similarities between this present study and the research of Scott & Brown (1991):

1. the anticipated number of subjects was similar to the values they reported and,
2. both studies also obtained the initial list of diabetic subjects from a clinic register list.

5.1.2. Subject Participation

Within the sample, individuals were considerably mobile. This fact was demonstrated by the difficulty in contacting those on the register. The lower subject population is not a desirable outcome, but unfortunately it is not abnormal. These observations are similar to problems experienced by Scott & Brown (1991), Shimakawa et al (1993) and Humphreys et al (1994). This project accounts for all the possible IDDM subjects in the Illawarra area, as all subjects initially listed on the register were eventually found.

5.1.3. Validation of Diet Intake Methods

Analysis of the results from the diet history demonstrates that the usage of this dietary assessment technique did not allow for reporting of who were irregular consumers of alcohol. Individuals consuming alcohol as part of their usual intake, that is 'Regular' consumers, were more inclined to have their alcohol intake reported by the diet history. This is supported by Cameron & Van Stavern (1988) who suggest that the diet history is not an accurate measure of irregularly consumed items, such as alcohol, as the diet history involves measurement of 'usually' consumed items. The format of the questionnaires promoted a higher number of alcohol related responses when compared to the diet history (refer Figure 4.2). Hence, the results of this study were difficult to compare with Rehm and Spuhler (1993) who reported the diet history as the more valid method for measuring alcohol intake.

The two types of questionnaires produced comparable results. The identification by the 'Practical Issues in IDDM' questionnaire of a 'regular, moderate' drinker, generally correlated to the frequency of alcohol consumed indicated by the DCCT questionnaire. Rehm & Spuhler (1993) described the effectiveness of the questionnaire as limited in comparison to the diet history. However, the efficacy of the particular self-administering questionnaires was possibly enhanced by the anonymous and non-intimidating nature of the report and response (Magarey, et al, 1993).

The possibility of under reporting in the questionnaires must be considered. Such under reporting resembles the form of answers that occurs in the diet history; ie reflection of 'usual' intake, when alcohol consumption may not be deemed as usual by

the participant. Another cause of under lies in the design of the DCCT study (Cypel & Sleinski, 1994). The DCCT study questionnaire items mostly focused on the frequency of alcohol consumption and not the amount of alcohol consumed, it had the most use as a check of the RFPS. Whereas the RFPS addressed both frequency and quantity of alcohol consumption, it offered more insight to the drinking behaviour of the study participants.

The partial completion of questionnaires by subjects affected the results, as these responses were rendered incompatible with other members of the study. This may have been indirectly caused by the sheer bulk of the questionnaire forms that were completed by each individual. Magarey et al (1993) suggest incorporation of an alcohol intake question into a large body of questions, however, in this present study this approach hampered results.

5.1.4. Alcohol Intake Trends

In this study comparison between diabetic and control subjects revealed that a higher percentage of control subjects consumed alcohol. This trend may indicate compliance of diabetic subjects to recommendations to reduce their alcohol consumption (ADA, 1995). Alcohol consumption by control subjects in this study was of a higher frequency than that reported by the National Heart Foundation (Risk Factor Prevalence Study Management Committee, 1990) and the Australian Bureau of Statistics (ABS, 1990).

The percentage of diabetic subjects consuming alcohol were similar to those found both by Humphreys et al (1994) and Close et al (1992). Sixty-seven percent of men were found to consume alcohol whereas 33 percent of women were alcohol consumers. These statistics confirmed that the sample of alcohol consumers that were studied correlated well to the expected sample size (Humphreys et al, [1994] ; Close et al, [1992]).

5.1.4.1. Frequency

Previous researchers if diabetes have focused on the effects of alcohol consumption per sec, largely ignoring the consequence of alcohol consumption frequency (Humphreys et al, 1994). Hence, the frequency of alcohol consumption amongst diabetic individuals, can only be compared with the literature of normal healthy subjects and the controls within this study. The diabetic male subjects within this study consumed alcohol more frequently than females, as shown by the RFPS results (refer Table 4.3). However, within the control population, the females tended to have more regular alcohol consumption.

5.1.4.2. Quantity

The results of this study reflected the findings of the RFPS (Risk Factor Prevalence Study Management Committee, 1990), describing a greater amount of alcohol consumed by males. Close et al (1992) defined the alcohol consumption of their study participants in terms of alcohol consumed per day. Since only a minimal number of the diabetic subjects in this study consumed alcohol on a daily basis, comparison with the Close et al (1992) study was not strictly valid.

5.2. Relationship between Alcohol Intake and HbA1c Values

5.2.1. Glycosylated Haemoglobin Values

A lower HbA1c value present in controls when compared to IDDM subjects was demonstrated by this study (refer Figures 4.1 & 4.2). The distribution of HbA1c values was similar to those of Peveler et al (1993), but this study did not show such elevated amounts.

Significant trends between grams of alcohol and HbA1c values were present only for diabetic individuals (refer Figure 4.8.). However, after the removal of an unusual value this significance was substantially decreased, resulting only in a slight positive trend between the frequency and quantity of alcohol consumed for the majority of diabetic individuals (refer Figure 4.9). Analysis of HbA1c values in the following paragraphs will concentrate on:

1. the non affected HbA1c values of the control group; and
2. the observed difference between the diabetic subjects who do not drink alcohol and the diabetic subjects who drink alcohol.

5.2 Effects of alcohol consumption on the HbA1c levels of non diabetic subjects

The absence of significance, as no trends were discernable between HbA1c levels and the amount of alcohol drunk with the control group, indicates that HbA1c levels remained unchanged by alcohol consumption. Facchini et al (1994), supported the findings of this present study with their results on 40 non diabetic subjects who

consumed 10-20 grams of alcohol. Facchini et al (1994) compared the insulin levels of these drinkers, with non drinkers and found that after a certain oral glucose load, the drinkers had a more effective insulin-mediated glucose response. This was indicated by lower plasma glucose levels than the non drinkers (Facchini et al, 1994), and offered suggestions as why the HbA1c alues were not elevated. This is also supported by similar findings of Mayer et al (1993), who found that non diabetic women who drank alcohol (consuming between 10g/week and 20g/day) have lower plasma insulin levels, indicating a more effective insulin-mediated glucose uptake system, thus leading to enhancement of glucose tolerance and normal HbA1c levels.

The results of this present study did not support the studies of Dornhorst & Ouyang (1971), Yki-Jarvinen & Nikkila (1985) and Gerard et al (1977), who found impairment of glucose tolerance amongst non diabetic subjects who drink alcohol. Elevation of blood glucose levels would have been indicative of impairment of glucose tolerance. The normal HbA1c values of the non diabetic subjects within this present study suggest no such imbalance in glucose metabolism.

5.2 Effects of Alcohol Consumption on the HbA1c levels of diabetic subjects

This study presents results showing a slight increase in HbA1c values of IDDM individuals in response to alcohol consumption, suggesting that with increasing amounts, and instances of drinking, diabetic individuals are more prone to elevated HbA1c levels. This is supported by Peveler et al (1993), who found that diabetic

individuals who drink 40g of alcohol/day, will be more prone to have elevated HbA1c values, than the diabetic individual who does not drink alcohol at all.

Impaired glucose tolerance would lead to elevated blood glucose levels, and hence elevated HbA1c (Gonen et al, 1977). The mild impairment of glucose tolerance through the consumption of alcohol was proposed by the research of O'Keefe & Marks (1977) and Avogaro et al (1983). These studies suggest the consumption of alcohol can mildly influence the plasma blood glucose levels of a person with diabetes.

Shimakawa et al (1993) reported no influence of alcohol consumption on HbA1c values of IDDM individuals, findings which are not supported by this present study. The observation of a slight change in HbA1c values in response to alcohol intake also does not support the studies of Walsh & O'Sullivan (1971), McMonagle & Felig (1975) and Koivisto et al (1993), who report alcohol consumption having no effect on the blood glucose levels and HbA1c values of a diabetic individual..

Chapter 6. Conclusion

Chapter 6. Conclusion and Limitations of Study

The initial aim of this study was to record the alcohol intake of the IDDM subjects in the Illawarra region in the most valid way. The attainment of a large number of diabetic individuals and matched controls was not possible for this study, however, all the subjects not recruited were able to be accounted (See Table 4.2). The use of the National Heart Foundation RFPS instrument (Risk Factor Prevalence Study Management Committee, 1990), proved to be the most efficient method of measuring the alcohol consumption amongst the diabetic and control subjects. The subjects in this present study consumed more alcohol than in previous research (Close et al [1992]; Risk Factor Prevalence Study Management Committee, [1990]).

The second aim involved investigating the effects of alcohol intake on the blood glucose control of individuals', namely through the measurement of HbA1c values. Overall, the results of this study was able to affirm only speculative positive relationships amongst the frequency and amount of alcohol consumed and the HbA1c values.

Limitations of this study were mostly centred around the smaller than anticipated study size. With more participants in the study, the observations of the slight trends between alcohol consumption and HbA1c may have become significant.

In an attempt to contact the subjects with no forwarding address, permission was granted from the Ethics Committee for this study to adopt the practice of Scott &

Brown (1991), ie approaching the local general practitioners for the patient's forwarding address. This may have introduced possible ethical problems, with the possibility of patient being irritated.

The diet history did not correlate with the FFQs used in this study, as this dietary method did not report many instances of alcohol consumption. Another problem was the large number of questionnaires. Often individuals missed out parts of questionnaires, specifically the alcohol consumption questions. This prompts the recommendations that the researchers should check all the questionnaires, prior to collection to ensure that all questions have been answered.

The RFPS (Risk Factor Prevalence Study Management Committee, 1990) investigated the frequency and amount of alcohol consumed by individuals. In application to this present study, this proved to be the most informative method of measuring alcohol intake. Problems arose in the definitions of the 'Occasional' drinker. Some individuals identified as 'Occasional' drinkers by the Practical Issues Questionnaire, then identified with the 'Never' consumed alcohol category for the RFPS Questionnaire (as shown by Table 4.2). Identification of the 'Occasional' drinker occurred after the subject had responded to the "Less than once a week" frequency category (See Appendix 1a). This particular time span does not indicate that the individual actually consumes alcohol, it could be three weeks in the month or only three times a year. The other definitions of frequency (Never and Regular) are at variance to extremes to the Occasional response: ie "I don't drink alcohol" or x amounts of alcohol per week (See Appendix 1a).

Problems with the 'occasional' drinker also arose in response to the DCCT questionnaire. This questionnaire rated its lowest alcohol consumption rate as "1-3 times a year or never". Due to logistical consideration the term 'never' was used in the DCCT questionnaire. This may have influenced the result by not allowing for the 'Occasional' drinker who only consumed alcohol one to three times a year (See Table 4.2).

This study was very limited in supporting any strong relationships between alcohol consumption and elevated HbA1c values. Alcohol consumption may not elevate HbA1c values at all, but this is hard to determine with the results obtained from this study. The small number of subjects may have played an integral role, as the unrecruited subjects, may have been the individuals more prone to noncompliance. Recruitment of these individuals may produce a more positive result.

Restructuring the questions asked may create different results, as it is important to know about the individuals drinking behaviour, in order to ascertain the effects of alcohol. Examples of such questions include, "Do you eat food, when you drink alcohol?. If yes, what type of food do you eat?" or "Have you ever experienced 'hypoglycaemia' after consuming alcohol?. If yes, how often does this occur?". Answers to these questions would give more insight to the blood glucose control of an individual in respect to their alcohol consumption.

Recommendations for improving this study include:

1. Longer recruitment period, in order to gain all the possible subjects,
2. Dietary methods should not rely on solely the diet history, as this as is not a good indicator of alcohol consumption. A better choice would be a questionnaire format . Clarification of the definition of the Occasional Drinker and, restructuring questions to include questions about drinking behaviour are other recommendations for the design of the dietary methods used.-

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Appendices

Appendix 1. Consent Form

UNIVERSITY OF WOLLONGONG

ILLAWARRA AREA HEALTH SERVICE

CONSENT FORM

FOR PARTICIPANTS WITH DIABETES

ASSESSMENT OF INSULIN-DEPENDENT DIABETES MANAGEMENT

This research on the current management of diabetes in the Illawarra is being conducted by a group of clinicians and scientists supported by a steering committee with representatives from the Illawarra Area Health Service, the NSW Health Department, and the medical profession. Professor Dennis Calvert in the Medical Research Unit (Illawarra Area Health Service/University of Wollongong) heads the group, and Ms Farideh Tahbaz is coordinating

Information relating to this study is detailed in the attached information sheet.

You are free to withdraw from all or part of this research program at any time without penalty, and without compromising in any way your treatment or access to services.

The ethical aspects of this study have been approved by the University of Wollongong Human Research Ethics Committee, which is responsible for the ethical aspects of research involving people in the Illawarra. If you have any enquiries regarding the conduct of the research please contact the Secretary of the University of Wollongong Human Research Ethics Committee on (042) 21 3079.

I understand that the information collected in this research will be used for the assessment of insulin-dependent diabetes management and I consent for the data to be used in that manner.

If you wish to take part in this research please sign below

.....
Name Signature Date

Appendix 2a. Practical Issues of IDDM (RFPS) questions used in study.

8. How often do you drink alcohol?

- I don't drink alcohol..... ☐ 1
 Less than once a week..... ☐ 2
 On 1 or 2 days a week..... ☐ 3
 On 3 or 4 days a week..... ☐ 4
 On 5 or 6 days a week..... ☐ 5
 Every day..... ☐ 6

9. On a day when you drink alcohol, how many drinks do you usually have?

- 1 or 2 drinks..... ☐ 1
 3 or 4 drinks..... ☐ 2
 5 to 8 drinks..... ☐ 3
 9 to 12 drinks..... ☐ 4
 13 to 20 drinks..... ☐ 5
 More than 20 drinks..... ☐ 6

Reproduced from : Risk Factor Prevalance Study Management Committee (1990), appendix B, pg 124.

Appendix 2b. DCCT food pattern Questionnaire items used in the study

	Daily	4-6 times a week	1-3 times a month	1-3 times a month	1-3 times a year or never	<u>Comments eg</u> seasonal variation, low fat product name etc...
BEVERAGES						
Beer, ale						
Spirits, cocktails						
Liqueur, Port,						
Brandy						
Wine, dry or						
sweet						

Appendix 3. Conversion of coded responses of NHF & DCCT questionnaires and HbA1c Values

1. Coded item 62 - HbA1c

<8%	=	Ideal
8-10%	=	Good
10-12%	=	“Average”
>12%	=	Poor

2. Coded items 98, 99, 100 & 101 - DCCT Food pattern ‘alcohol’ items (Beer, Spirits, Liqueur & Wine)

1	=	Daily
2	=	4-6 times a week
3	=	1-3 times a week
4	=	1-3 times a month
5	=	never

3. Coded item 294 - Frequency of drinking (How often do you drink alcohol)

1	=	Never
2	=	Occasional
3	=	Regular
4	=	Regular
5	=	Regular
6	=	Regular

4. Coded item 295 - Amount of alcohol (On a day when you drink alcohol, how many drinks do you usually have)

0	=	0g	=	None
1	=	15g	=	Light
2	=	35g	=	Moderate
3	=	65g	=	Heavy
4	=	105g	=	Heavy
5	=	165g	=	Heavy
6	=	200g	=	Heavy